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TIMBER STRESS GRADING:

RECOMMENDATIONS FOR NATIONAL TRAINING PROGRAMMES

*AND QUALITY ASSURANCE**

by

Timber Research and Development Association **

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PREFACE

This document was prepared following recommendations made by the Expert Group Meeting on Timber Stress Grading and Strength Grouping, Vienna, Austria, 14 - 17 December 1981 in conjunction with the development of 'Model Stress Grading Rules' and an evaluation of current industry practices and research programmes in this field.

These are reproduced as background material for the Expert Group Meeting on Timber Construction, Vienna, 2 - 6 December 1985.

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INTRODUCTION

The adoption by a country of the model rules for the stress grading of tropical timber will need to be followed by two further steps for the implementation of these rules to achieve the objectives intended.

(1) A programme of information and encouragement to specifiers and users to adopt stress graded timber in their construction projects;

(2) The training of stress graders and continuing surveillance of their grading so that users will have a reliable supply of properly graded timber available to them.

This paper concerns the second of these activities. It is considerably influenced by TRADA's own experience of responsibility for both training and quality assurance of the United Kingdom but does not blindly follow TRADA's UK practice.

The dependable quality of visually stress graded sawn timber can be assured by:

(1) correct training and initial certification of graders;

(2) continuing re-examination of graders as to their competence;

(3) quality control of the grading process exercised by the producing company;

(4) independent surveillance of the quality of grading of the company's output.

A question to which different countries may find different answers is that of responsibility for the various activities described in this paper.

This paper presumes the establishment of an Inspection Agency which will provide a team of inspectors who will carry out the essential activities of periodically re-examining graders as to their competence and carrying out random or batch inspections on a sampling basis. Inspectors should preferably be certificated graders with experience of commercial grading, but this will be difficult to ensure in the early days of the agency's operations. It is strongly recommended that senior inspectors from this team should act as examiners for the initial examination of graders and it is suggested that inspectors should be available to producing companies who would otherwise have difficulty in arranging for the internal quality control of their graders' work. It

is possible also that inspectors could provide a commercial grading service in appropriate circumstances provided that their inspection function has priority. This grading service would be particularly useful and economical in the early days of stress grading in any country.

The question of who should provide training is a very open one. Most countries will have existing colleges or institutes which could provide such training and it is thought that it would normally be cost effective to use suitable existing establishments. The effectiveness of this training can be coordinated on a national basis by the use of senior inspectors from the Inspection Agency as examiners. The examiners should liaise with training staff to ensure nationally consistent standards, and more specifically, the suitability of timber stocks used for examination purposes. It would of course be possible for the Inspection Agency itself to provide training.

Inspection Agencies are likely to be national agencies though it is possible that they should be based on smaller areas such as states or convenient geographical areas, in which case their activities should be coordinated by a committee established on a federal or national basis.

It is important to appreciate that grading is a production process. The grader is not an inspector checking on the quality of a prior process. He is himself carrying out a process that has not previously been carried out. For this reason the graders' activities need to be the subject of internal quality control and this is the reason for the inclusion of (3) above.

Since it will generally be the companies that make potential graders available for training, and since it is companies that have to take commercial responsibility for the quality of their production, it seems logical that the governmental or quasi-governmental agency responsible for the surveillance of timber grading should deal with the companies rather than with graders individually. This recommendation also has the merit of reducing quite considerably the bureaucratic process involved.

The general framework of the overall training and quality assurance process is accordingly seen as follows:

(a) Potential graders are made available by companies for training along with other personnel who need to appreciate the grading process, the training being carried out by an appropriate college or institute.

(b) *All personnel taking the training course are examined at the end of the course and receive a personal certificate if they are successful in passing the examination. Copies of the certificate are passed to the company and the quality assurance agency.*

(c) *Companies register with the Inspection Agency those personnel intended to be active graders and provide these graders with the status and practical recognition that their new duties justify. Only certificated graders should be allowed to grade constructional timber.*

(d) *Companies arrange internal procedures to monitor the performance of their graders and may make use of agency inspectors to assist this process. It is suggested that any such assistance should be provided at cost to the company whether or not other agency activities are partly or wholly charged to companies.*

(e) *The Inspection Agency will arrange for the periodic re-examination of all registered graders by their inspectors.*

(f) *Procedures should be established for companies to inform the Inspection Agency when timber being supplied to official contracts will be available for batch inspection or when there has been release or despatch of stress graded stocks for sale for general constructional use.*

A problem associated with the surveillance of visual grading is that there are strong commercial pressures not to carry graded stocks and for individual requirements to be graded on demand. For this reason it may be very likely that inspectors will find few stocks on which to make random checks when visiting companies. For this reason emphasis is placed on both the re-examination of graders as to their competence and on the notification to the agency of the availability of quantities of graded timber for inspection. The agency may decide whether or not to carry out an inspection of any particular quantity of timber that has been notified to them. The notification of small quantities of graded timber may be excused.

Where grading is being carried out at the original sawmill, rather than at some depot or elsewhere, it is more likely that the stress grading of constructional sizes will be carried out regardless of the availability of orders and prior to the allocation of timber to specific orders. It may be possible to encourage the stress grading of all such

appropriate specific sizes by generally excusing such companies from batch inspection procedures in favour of the periodic random unannounced inspection of graded stocks by agency inspectors.

TRAINING

Most stress grading experience has been in the context of softwood and the combined effect of the profusion of knots and the small diameter of many softwood logs results in grading rules having to be comparatively complex in order to deal adequately with the problem of the reduction of strength due to knots. The same problem is met in the case of coniferous timbers grown in tropical countries and also in the case of plantation grown hardwoods such as the eucalypts which may be harvested as soon as they reach a size providing a reasonable yield of construction timber.

For this reason separate grading rules are supplied for tropical hardwoods and conifers, the main distinction being the treatment of knots which can be simpler in the case of tropical hardwoods (excluding plantation grown hardwoods as indicated above).

In both cases, the rules are based on a surface measurement approach to knots as opposed to the so-called knot area ratio method. This choice results in grading rules that will seem simpler to most people and the result of this decision is likely to be a greater examination pass rate rather than a reduction in the time taken for training.

The rules for tropical hardwoods are significantly simpler as regards knots since these are of limited occurrence in trees from natural forests. On the other hand interlocked grain is a problem in many tropical hardwood species since this can be confused with slope of grain.

Obviously, the time required for training courses will depend to a considerable extent on the levels of intelligence and ability of those chosen for training. This will vary from country to country and the availability of suitable jobs for higher educated people in rural areas is likely to be a key factor. TRADA agrees with the findings of the Expert Group Meeting in December 1981 that trainees should have had practical experience in a sawmill and that a minimum educational level should be satisfied. Alternatively, a suitable aptitude test might be developed to screen people who might not benefit from training.

Broadly, it is TRADA's opinion that the simplest requirement, namely to grade tropical hardwood species from natural forests, could be achieved within a full six day working week in the most favourable of circumstances. The rules for coniferous timbers would require the equivalent of two to three weeks. The Expert Group were thinking in terms of five to six weeks and it may be found in some circumstances that this length of time will be needed. However, it is TRADA's recommendation that no course should be of more than 3 weeks duration unless problems are found.

Training at TRADA is normally of two weeks duration and it has always been found convenient in the circumstances of the UK to provide a lapse of four to eight weeks between the two weeks of the training course. It is thought to be quite practicable but marginally less satisfactory to provide the training in two consecutive weeks.

An exam should be held on the last day of every course and this should be partly written and partly practical. The written part of the examination is more appropriate to the establishment of the candidate's essential understanding of grading, while the practical part of the examination establishes his ability to put this understanding into practice. A purely practical examination is likely to favour those candidates with good short-term memory who may be able to achieve a pass without having an essential understanding of the principles.

The syllabus and the timetable of the training should be made to suit the requirements of those who are intended to be active company graders, though many others in the timber and construction industries who require a good working knowledge of grading should find the course useful for their needs also. There will probably also be benefit to be obtained from a short appreciation course for management and sales personnel but in this case there is no need for an examination at the end of the course and there should be no question of any certificate being granted.

The syllabus of a full course should be along the following lines:

(1) Assembly and administrative introduction.

(2) Wood, the material and its mechanical properties; recognition of species.

(3) Background to stress grading.

(4) Introduction to the grading rules appropriate to the course.

(5) *Defects other than knots and their measurement and assessment (in the case of tropical hardwoods interlocked grain will need special attention and the rules regarding brittleheart may need mention).*

(6) *Practical exercises on defects other than knots.*

(7) *Knots, the different types (this need only be quite brief in the context only of tropical hardwoods from the natural forest).*

(8) *The measurement and assessment of different types of knot.*

(9) *Practical exercises on knots.*

(10) *Introduction to the two different grade rules.*

(11) *General grade rules.*

(12) *Practical exercises on general grades.*

(13) *The special grade rules.*

(14) *Practical exercises on special grades.*

If the course is split into two separate periods of time then this is the point at which there should be a review of stress grading techniques and an individual check of comprehension prior to the break. After the break there should be a recapitulation of theory and practical techniques and then:

(15) *Practical exercices in groups.*

(16) *Practical exercises as individual graders.*

(17) *Mock examination.*

(18) *Examination.*

Instruction should be restricted to the circumstances appropriate to each situation. For example, there should be no training given in the grading of conifers if these are not available commercially to the companies employing the graders. The syllabus and duration of a course will need to be related to the circumstances, and need be no longer than these circumstances dictate.

Practical experience shows that it is not possible to organize successful courses on the basis of timber stocks generally to be found in timber yards with little or no selection. Timber for training purposes needs to be carefully chosen to illustrate the principles involved and the examination stock should be selected so as to avoid ambiguous results. The selection of these stocks is time consuming and cannot be seen to be practical in the context of a single course to be held at a sawmill or similar venue where repeat courses in the foreseeable future

are unlikely. This is a serious logistical constraint and leads TRADA to question the opinion of the Expert Group that courses should be held at sawmills. It might of course be possible for a college or institute to run courses at a conveniently located sawmill rather than at their own premises, but the idea of running courses at a number of mills to minimize travel and to suit the convenience of the industry has to face this problem of selecting suitable timber stocks.

PERIODIC RE-EXAMINATION OF GRADERS

It is considered that graders should be re-examined periodically as to their competence even when considerable quantities of the graders' work may be subject to random or batch inspections. While it may be argued that a grader who produces results that satisfy regular inspections need not be the subject of any further check, this re-examination is not solely to check on the competence of a grader but is intended to help the grader retain that competence. Constructive criticism may be provided in circumstances where no commercial consequences are involved as would be the case where a random or batch inspection was being carried out. The possibility of over-grading and its economic consequences may be kept in check.

INTERNAL QUALITY CONTROL

Companies should be recommended to keep the work of their graders under surveillance in between random or batch inspections carried out by agency inspectors. Where a grader's work is the subject of a recent or substantial batch inspection then it should be possible to excuse him a corresponding amount of internal quality control procedure. This internal quality control will be most improtant where comparatively small quantities of graded timber are being produced and visits from agency inspectors may be relatively infrequent.

This internal quality control is particularly important since the cost burden of agency inspection should be capable of being reduced if producing companies' own quality control is found to justify a relaxation of the level of inspection. It is much healthier for the industry to produce satisfactory quality on the basis of their own high standards of control.

Internal quality control is not too difficult where several graders operate at the same company since programmes of cross-checking can readily be devised, particularly if this can be done under the surveillance of a more senior grader. Where the company has only one grader on site then it should be possible for arrangements to be made with the Inspection Agency for supplementary visits to be made on an informal basis.

It is suggested in the next section that account should be taken of a company's internal quality control procedures when determining the overall level of surveillance to be applied. It is very important that any such internal quality control shall be properly documented and the records of inspections kept available for examination by the agency inspector. Only in these circumstances should the Agency give any credit to internal quality control procedures such as would reduce the amount of external surveillance considered to be adequate.

It should be emphasized that the Inspection Agency itself must institute and maintain quality control of its own inspectors' operations.

INDEPENDENT SURVEILLANCE

The problem of providing independent surveillance of visual stress grading is made more difficult by the fact that there are many reasons why companies may not maintain stocks of stress graded timber on site, preferring to grade on ad hoc basis to satisfy requirements. Typically this will be the last process to be carried out on a batch of timber prior to despatch and the chances of a random unannounced visit by an agency inspector coinciding with the availability of graded stock on site may be quite small.

On the other hand, a sawmill producing substantial quantities of constructional sizes and grades of sawn timber may find it worthwhile to grade all such material on a grading chain and to accept as a matter of small consequence that some proportion of this material will be sold in circumstances which do not strictly require the provision of stress graded timber.

In these latter circumstances it is comparatively easy to arrange for random unannounced visits by agency inspectors several times a year with the full expectation that there will be graded material on site

for them to examine. In the former case arrangements have to be more complex and it is probably necessary for companies to inform the inspection agency of the coming availability of batches of timber for official contracts or for supply into stockholdings of stress graded timber that may be held by the sawmills customers.

It is difficult to make positive proposals for any particular situation until the facts are known regarding the demand for stress graded sawn timber from the mill concerned and the way in which the sawmill intends to respond.

The overeall quality assurance effort as a company will be a combination of random unannounced surveillance and batch inspections by agency inspectors together with the documented internal quality control procedures carried out by the company. Bearing in mind that the throughput of stress graded sawn timber may vary considerably from one sawmill to another it should be the duty of the Inspection Agency to ensure that the burden of inspection should fall on each company on an equitable basis. The programme of visits to each company should be tailored to suit the variety and throughput of timber graded by that company.

Disciplinary action will need to be taken by the Inspection Agency in respect of incompetence, carelessness or worse on the part of graders, and of inadequate supervision or quality control on the part of companies. In some cases poor company attitudes to quality assurance may lead to bad grading or misuse of stamps. The action that may be taken would include official warnings leading to additional inspection which should be charged to companies, suspension of graders or companies till appropriate remedial action has been taken, and in the worst of cases complete withdrawal of grading rights.

If the Inspection Agency has the statutory right to do so, it may arrange inspection of graded timber on construction sites, and may in any case agree with companies that batch inspection at site may in some cases be more convenient than at the sawmill. There could also be collaboration between the Agency and the building control authorities to arrange some sampling of quality on site or to follow up reports of poor quality timber received.